OPERATION AND SERVICE MANUAL

WEINSCHEL ENGINEERING CO., INC.
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GAITHERSBURG, MD 20877

REVISION INFORMATION IS LOCATED AT THE
REAR OF THIS MANUAL.

SYSTEM II
SOFTWARE OPERATIONS

(*S2CAL* AND *MANIDF* PROGRAMS)

IM-181

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Weinschel Engineering
Gaithersburg, Maryland
1985

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SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

This manual explains remote operation of the System II Automatic Calibration System using the System II calibration software package.

HARDWARE DESCRIPTION

The System II is comprised of several devices which together allow the transfer of calibration factors with traceability to the National Bureau of Standards. The calibration factors are transferred between a feedthrough thermistor mount (e.g. the WE 1109) and:

- a terminating thermistor mount (WE 1110); or
- a power meter and sensor.

The heart of the System II consists of a generator which is level-controlled by the combination of an 1805A RF level controller and a Weinschel Engineering feedthrough mount. The thermistor mounts work on the principle of dc substitution. For more information about the System II hardware, refer to the *System II Automatic Power Meter Calibration System Operation and Service Manual* (W/E part no. IM154).

This software package applies to System IIs which operate in the .01-18 GHz frequency range using:

- a WE 1109 feedthrough mount or a WE 1807; and
- a WE 1110 terminating mount.

Note that other mounts are available that may operate in other frequency ranges. For example, a WE 1111 mount may be used with a Polarad SMS-2 signal generator for a System II in the .1-100 MHz range.

SOFTWARE DESCRIPTION

The System II software package includes two programs, *S2CAL* and *MANIDF*. *S2CAL* allows automatic transfer of calibration between thermistor mounts and power meter sensors.

Because the System II always *transfers* calibration, one of the thermistor mounts must have known calibration data. This data is stored in a data file on disc or tape. The data file contains 109 frequencies and corresponding calibration factors for a range of .01 to 18 GHz traceable to the National Bureau of Standards.

The *MANIDF* program allows manipulation of the associated data files, i.e., to make, print and copy data files for a thermistor mount, an adapter, or a 30-dB attenuator .

1.2 CONTROLLER OPTIONS

System II software can be used with a variety of bus controllers, RF generators, power meters, and voltmeters. The System II software package is available in a variety of forms, dependent on the controller used to operate the system. See Table 1-1.

Table 1-1. CONTROLLER OPTIONS AND AVAILABLE SOFTWARE

CONTROLLER	SOFTWARE ON:	WEINSCHEL ENGINEERING PART NO.:
Hewlett Packard 80 Series Controllers*:		
HP Model 85 Controller	cassette tape	189-3-1
HP Model 86 Controller	3 ½" disc	189-3-2
	5 ¼" disc	189-3-3
Hewlett Packard 9000 Series 200 Controllers: HP Model 216 Controller (9816) HP Model 226 Controller (9826) HP Model 236 Controller (9836)	3 ½" disc	189-3-4
	5 ¼" disc	189-3-5

* Configured with full IEEE-488 bus interface capability.

1.3 CONTROLLED DEVICES

The main System II calibration program, *S2CAL*, is capable of controlling various devices over the IEEE-488 bus. Compatible RF sources include:

RF SOURCES

- Weinschel Engineering 4310
- Weinschel Engineering 4312 System
- Weinschel Engineering 4312A System
- Weinschel Engineering 4370 Series
- Hewlett Packard 8350 Sweep Oscillator
- Hewlett Packard 8340/8341 Synthesized Sweepers
- Polarad SMS
- EIP 928/931*
- Wiltron 6600 Series*

* Not available with Software Version A.

POWER METERS

Compatible power meters include:

- Hewlett Packard 436
- General Microwave 475
- Pacific Measurements 1045
- Boonton 4200
- Marconi 6960

VOLTMETERS

When calibrating a thermistor mount (WE Model 1109 or 1110), or when calibrating a power meter without an IEEE-488 interface bus option, it is necessary to use a bus-controlled digital voltmeter. Compatible voltmeters include:

- Fluke 8500 Series
- Hewlett Packard 3455 or 3478
- Keithley 192
- Datron 1065 (not recommended)

SECTION 2
OPERATION

2.1 USING THIS DOCUMENTATION WITH VARIOUS CONTROLLERS

This manual applies to the software for the HP Series 80 and HP 9000 Series 200 controllers. The program is menu-driven via the controller's programmable function keys. The options available are displayed on the screen in positions corresponding to the function keys. The position of these displayed options vary between controllers to facilitate program use. For this reason, the pictures of menus in this manual may not be entirely consistent with the menus displayed by a given controller. Proceed according to the menus displayed on the given controller.

2.1.1 Use with HP-80 Series Controllers

Compatible software is available for the Hewlett Packard Models 85 and 86 Controllers. These controllers have several common operations.

To load and run the program, proceed as follows:

A. Power up the controller.

B. Insert the software disc (for the HP 86) or the tape (for the HP 85) into the drive.

C. Type *Load "S2CAL"* and press the **END LINE** key.

D. Allow a short interval for the program to be accessed.

E. Press the **RUN** key when the drive light goes out.

The program provides interaction between the user and the bus controller via the controller's keyboard. In many instances, the program provides a prompt followed by a question mark.

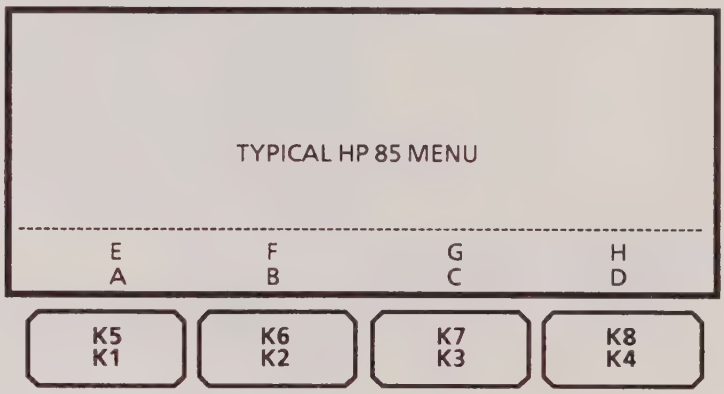
```
Enter serial # of 1110 mount to
be calibrated
?
```

Answer by entering a serial number, for example 201, and press the **END LINE** key.

The software is menu-driven. Interact with the various menus by pressing the controller's programmable function keys relative to the position of options displayed on the menus. This interaction with the menus differs slightly between HP 80 Series Controllers due to differences in their function keys. Refer to Paragraphs 2.1.1.1 and 2.1.1.2 for specific instructions.

2.1.1.1 HP 85 FUNCTION KEYS

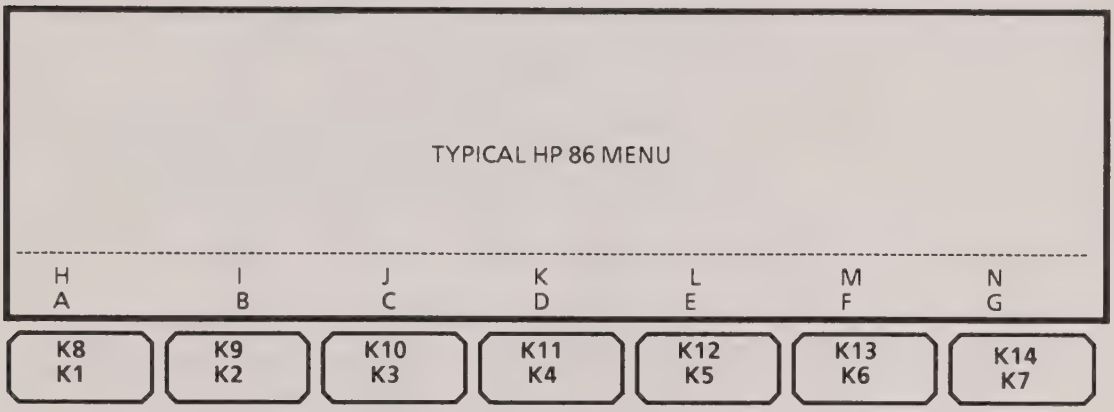
On the HP 85 Controller, interact with the menu by pressing the programmable function keys, **K1** thru **K8**, shown below.



To select a function shown in the A thru D positions, press the appropriate **K1** thru **K4** key. To select a function shown in the E thru H positions, press the **SHIFT** key and the appropriate **K5** thru **K8** key at the same time.

2.1.1.2 HP 86 FUNCTION KEYS

On the HP 86 Controller, interact with the menu by pressing the programmable function keys, **K1** thru **K14**, shown below.



To select a function shown in the A thru G positions, press the appropriate **K1** thru **K7** key. To select a function shown in the H thru N positions, press the **SHIFT** key and the appropriate **K8** thru **K14** key at the same time.

2.1.2 Use with HP 9000 Series 200 Controllers

Compatible software is available for the Hewlett Packard Models 216, 226, and 236 Controllers (a.k.a. 9816, 9826, and 9836 respectively), which is written in BASIC 2. This software is compatible with and will run on versions of Basic 3.0 and higher. On loading a program in a higher Basic, however, the following warning may appear:

"WARNING: PROG contains BIN with invalid revision".

This message may be ignored; the program will still operate. In order not to get this message every time, it may be desirable to RE-STORE the newly configured program.

Basic 3.0 powers up to an extremely basic state and requires several binary routines before it is able to catalog discs, do graphs, do IEEE transfers, etc. A program called *LOADBIN* is provided on the W/E System II software package to load the binary routines required to run the main System II program.

The following procedure indicates how to load and run the main program *S2CAL*, including the steps required if using Basic 3.0.

A. If disc-based Basic, insert Basic disc into drive; otherwise, insert System II disc into drive.

B. Power up the disc drive.

C. Power up the controller. Wait for the drive light to go out. When ready the controller will display "Basic X.0" where X is the current Basic level.

D. In Basic 3.0 *only*:

1. Remove the Basic disc.
2. Insert the System II disc.
3. Type *Load "LOADBIN"* and press the **EXECUTE** key.
4. Press **RUN**.
5. Follow the instructions that the program provides to load up the required binary routines.

E. Insert the System II disc.

F. Type *Load "S2CAL"* and press the **EXECUTE** key.

G. Press the **RUN** key.

The program provides interaction between the user and the bus controller via the controller's keyboard. In many instances, the program provides a prompt followed by a question mark.

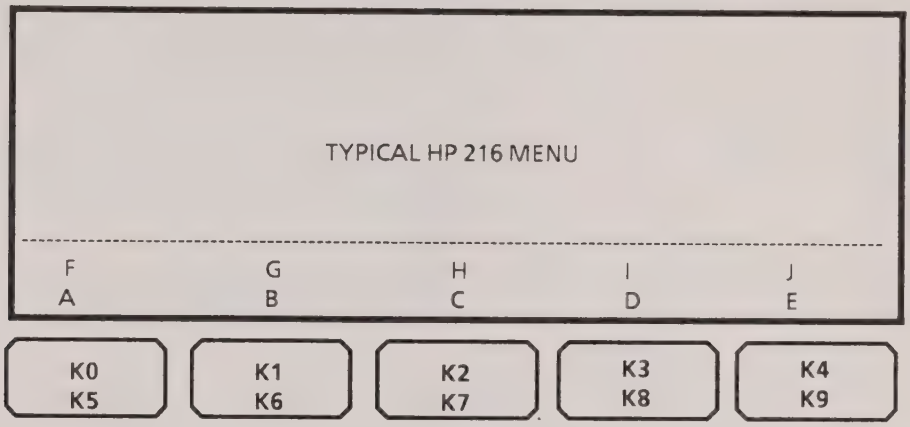
```
Enter serial # of 1110 mount to
be calibrated
?
```

Answer by entering a serial number, for example 201, and by pressing the **ENTER** key.

The software is menu-driven. Interact with the various menus by pressing the controller's programmable function keys relative to the position of options displayed on the menus. This interaction with the menus differs slightly between HP Series 200 Controllers due to differences in their function keys. Refer to Paragraphs 2.1.2.1 and 2.1.2.2 for specific instructions.

2.1.2.1 HP MODEL 216 FUNCTION KEYS

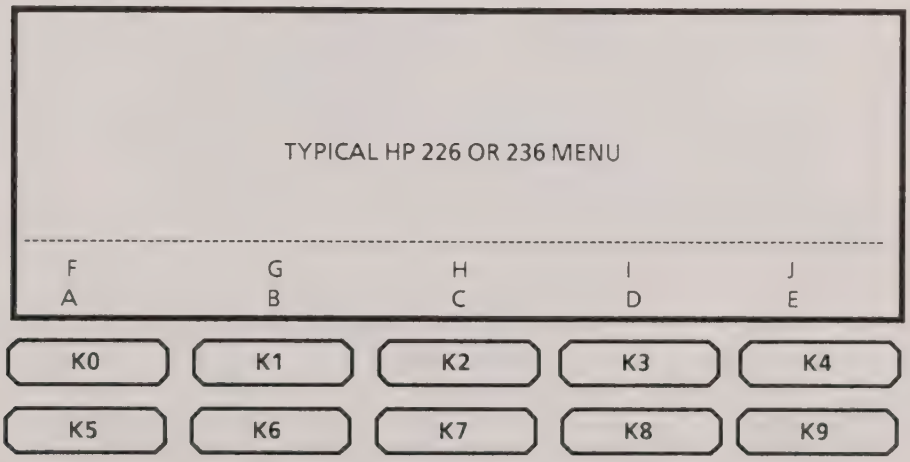
On the HP Model 216 (a.k.a. 9816) Controller interact with the menu by pressing the programmable function keys, **K0** thru **K9**, shown below.



To select a function shown in the A thru E position, press the appropriate **K5** thru **K9** key. To select a function shown in the F thru J position, press the **SHIFT** key and the appropriate **K0** thru **K4** key at the same time.

2.1.2.2 HP MODELS 226 AND 236 FUNCTION KEYS

On the HP 226 and 236 (a.k.a. 9826 and 9836) Controllers interact with the menu by pressing the programmable function keys, **K0** thru **K9**, shown below relative to the displayed options. Note that all functions are obtained directly without pressing the **SHIFT** key.



2.2 REMOTE SETUP INSTRUCTIONS

To set up the System II for remote operation, proceed as follows:

A. Follow the setup procedure for remote system configurations described in Paragraph 2.2.1.2 of the *System II Automatic Power Meter Calibration System Operation and Service Manual* (IM154).

BUS ADDRESSES

B. Set the IEEE-488 bus address for each device as listed in Table 2-1. The System II software presumes that the bus addresses have been set as indicated.

Table 2-1. IEEE-488 BUS ADDRESSES

INTERFACE SELECT CODE	BUS ADDRESS	DEVICE
	00	1805A RF Power Level Controller
	01	generator
	02	EIP 575 Frequency-locking Counter (used only when a WE 4312A system is used as the RF generator).
	04	digital voltmeter
	06	disk drive* (not HP 85)
	07	external printer (using an external printer on an HP 85 requires the presence of a PRINTER/PLOTTER ROM)
	13	power meter
7	21**	HP interface

*Recommended.
**HP factory set.

C. Load the software into the controller according to the instructions in Paragraph 2.1.1 or 2.1.2 of this manual.

ENTERING DATE

D. Upon power up, enter the date using the format described in the prompt.

2.2.1 Printer Selection

Upon entering the date, the controller displays the following message:

```
                WEINSCHEL ENGINEERING
                     SYSTEM II
                   Date: 11/06/85
Choose printer:

External      - on IEEE addr 07

None          - shows data on screen
-------------------------------------------------------------
EXTERNAL:
THINKJET      OTHER        |    HP85    |    NONE
```

Following the prompt, choose one of the available print options. These are:

- **THINKJET**: HP 2225A Thinkjet Printer
- **OTHER**: external printer
- **HP85** (HP85 only): the controller's integral printer.
- **NONE**: shows data on the screen only

Note that choosing an external printer (**THINKJET** or **OTHER**) presumes that the printer's interface bus address switch is preset to 07.

PRINTING A GRAPH FROM THE HP 85 ON AN EXTERNAL PRINTER

The *S2CAL* program is capable of plotting and outputting a graph of data for printing. In order for an HP 85 controller to output a graph onto an external printer (**THINKJET** or **OTHER**), it must be configured with a Printer/Plotter ROM. Also, appropriate lines in the COPY routine must be enabled. These lines are suppressed from the factory to ensure that the program will run on any HP 85 in the field. To upgrade the HP 85 with graph printing capabilities follow the steps outlined below:

A. Turn the controller off.

B. Insert the Printer/Plotter ROM.

C. Power up the controller.

D. Press the **LIST** key or enter "List". The program listing will be displayed on the screen.

E. Scroll through the program to get to the COPY routine. These lines, labelled "ROM", are disguised as comments. To enable them remove the initial exclamation marks (!) from the appropriate lines shown below:

```
PRINTER IS R,132
SETGU @ MOVE 0,100
BREAD Q$,32
SETUU
```

F. **RUN** the program. Initialization of the program takes a few moments.

G. Back up the upgraded version of the program under a new name, e.g. *S2CALX*.

2.2.2 RF Generator Selection

After choosing a print option, the following display appears:

```
                WEINSCHEL ENGINEERING
                     SYSTEM II
                   Date: 11/06/85

Choose      generator - on addr  01

            counter (eg 4312A)   02

-------------------------------------------------------------------------
WE4310      WE4370s     POLARAD     EIP931*
WE4312      WE4312A     HP          WILTRON*
```

*Not available with Software Version A.

The program can operate using several different generators. These are listed in Paragraph 1.3. Indicate which one of the displayed RF generator options is being used. Note that choosing a generator presumes that the selected generator's bus address has been preset to 01. If using a WE 4312A System, it also presumes that the 4312A's EIP575 Counter address has been preset to 02.

Note that the **HP** option is used to select models HP8350, HP8340 and HP8341.

2.3 MAIN CALIBRATION MENU

The program then displays the main CALIBRATION MENU:

CALIBRATION MENU

```
                    WEINSCHEL ENGINEERING
                          SYSTEM II
                       Date: 11/06/85

Choose calibration type:

-------------------------------------------------------------------------
SYSTEM2:                          | PMETER
1109          1110                | SENSOR
```

Use this menu to select the type of calibration being performed. The *S2CAL* program can be used to automatically calibrate a thermistor mount (a WE 1109 or 1110; refer to Paragraph 2.4) or a power meter sensor (refer to Paragraph 2.5).

2.4 THERMISTOR MOUNT CALIBRATION

2.4.1 Recording the Serial Number of the Mount

If the **1109** or **1110** option has been selected, the program will request the serial number of the mount to be calibrated. Note that the display indicates the type of calibration being performed (i.e., "CAL OF 1110 THERMISTOR MT"). Follow the prompt to enter the serial number of the mount. Subsequent menus and outputs will now display the serial number. This allows easy identification of calibration output data.

2.4.2 Entering the Data File Name of the Transfer Standard

The program will then request the data file name of the mount being used as the calibration standard. The System II always *transfers* calibration. Known calibration data from one device, stored in a data file, is transferred to the device being calibrated. For example, if calibrating an 1110, the program will ask for the data file name of the 1109, the known mount. The data file name is usually of the form "SNxxx" where "xxx" corresponds to the serial number of the device being used. The data files for WE 1109 and 1110 mounts that are part of the System II are stored on the tape/disc when shipped . To create and store new data files, refer to Appendix A of this manual.

2.4.3 Adapter Option

It is recommended that mounts with matching connectors be used in order to preclude the need for an adapter. However, if use of an adapter is unavoidable, the System II can account for adapter calibration factors in its calculations.

Once the data file name of the known mount has been registered, the program displays the prompt:

Are you using an adapter?

When using an adapter between mounts (for example, between an N-type and an APC-7 type mount), it is necessary to account for the calibration factors of the adapter in use. This information must be pre-stored in a data file on the system. For instructions on how to create and store adapter data files, refer to Appendix A of this manual. If using an adapter, select **YES**. The program will respond with the prompt:

Enter data file name for adapter.

If no adapter is being used, select **NO**.

2.4.4 Selecting Amount of DC Substituted Power

Next enter the value of dc substituted power to be supplied by the WE 1805A RF Leveller. This is typically 1 mW. Always set any RF generator for a power level slightly above that desired to ensure signal lock. This accounts for frequency-dependent power losses associated with the System II (cables, power splitter, etc.) Also, the 1805A can only level *down* power levels provided by the 4310, 4312, or 4312A sources.

To verify that the signal is locked, ensure that the **BRIDGE BALANCE** meter on the 1805A momentarily deflects and then immediately returns to zero when the RF is turned on initially. If lock cannot be achieved, check the RF generator power level.

NOTE

In the RF off condition, before the start of each run, adjust the meter to the zero position using the coarse and/or fine adjust knobs.

2.4.5 Selecting the Voltmeter

The program can be operated using several voltmeters. These are listed in Paragraph 1.3. Select one of the available options from the following menu:

```
                    WEINSCHEL ENGINEERING
                         SYSTEM II
                CAL OF 1110 THERMISTOR MT, 201
                        USING SN108
                        Date: 11/06/85

Choose voltmeter - on addr 04

-------------------------------------------------------------------------

                FL8505                                  HP3455
KEITH           FL8502          DATRON                  HP3478
```

2.4.6 Performing a Calibration Run

Once all parameters have been selected the program will display the RUN MENU:

RUN MENU

```
                    WEINSCHEL ENGINEERING
                         SYSTEM II
                CAL OF 1110 THERMISTOR MT, 201
                        USING SN108
                        Date: 11/06/85
Choose run:
        COMPLete        - all 109 frequencies
        BAND            - a choice of bands
        FIXED           - 1 fixed frequency
        CONSECutive     - run of NBS freqs,
                          specify start and stop freqs.
-------------------------------------------------------------------------

COMPL           BANDS           FIXED           CONSEC
```

The System II allows accurate measurement of up to 109 calibration points which are traceable to the National Bureau of Standards. The *S2CAL* program allows for calibration using several run options:

A. **COMPLete**: When selected, this option automatically performs calibration at all 109 points. This takes approximately 20 minutes. The data, including a table of calibration factors and a plotted graph, are automatically output on the screen and on the preselected printer. The controller then displays the OUTPUT MENU (see Paragraph 2.4.7 below).

Press the **ABORT** key to terminate the run if necessary. This advances the display to the OUTPUT MENU.

B. **BANDS**: This option performs calibration over a choice of frequency bands, each with approximately 20 points. If this option is selected, the BAND SELECTION MENU is displayed:

BAND SELECTION MENU

band	from (GHz)	to (GHz)	step (GHz)
1	.01	1	.1
2	1	2	.1
3	2	4	.2
4	4	8	.2
5	8	12.4	.2
6	12.4	18	.25
7	.01	18	1
8	.01	4	low

Select band?

Bands 1 thru 6 are runs of consecutive NBS frequency points.

Bands 7 and 8 are customized runs. Band 7 consists of 10 MHz, 50 MHz, and then 1 - 18 GHz in 1-GHz steps. This run coincides with the frequency range of the HP 8481 sensor. Band 8 consists of 10, 50, 100 and 500 MHz and then 1 - 4 GHz in 1-GHz steps. This run coincides with the frequency range of the HP 8482 sensor.

Choose the desired frequency band; the calibration will automatically be performed. Upon completion of the run, the controller displays the OUTPUT MENU (See Paragraph 2.4.7 below).

Press the **ABORT** key if it is necessary to terminate the run. This advances the display to the OUTPUT MENU.

C. **FIXED**: This option performs calibration at a single selected frequency. When this option is selected, the program displays the prompt:

```
Enter frequency (MHz)
Hit (ENDLINE) to abort
?
```

Enter the desired frequency. The run will automatically be performed. Because the controller is requesting the user to type in specific information, all special function keys, including **ABORT**, are disabled. Therefore, if it is necessary to abort the run, hit the **END LINE** key as the prompt indicates.

Because a fixed run only provides data for one point, no graph can be plotted and no print options are available. Therefore, when a fixed run has been performed or aborted, the program bypasses the OUTPUT MENU and advances to the NEWRUN MENU (See Paragraph 2.4.8 below).

D. **CONSECutive**: This option allows the user to select a consecutive band of calibration points from among the 109 NBS traceable points. The user selects a start frequency and a stop frequency. The system then calibrates those points and all points within the specified range. If a start or stop frequency which is not among the 109 available points is selected, the system defaults to the nearest NBS traceable point. Upon completion of the run, the controller displays the OUTPUT MENU (See Paragraph 2.4.7 below).

During a run, the controller displays the data on the screen. A sample run is shown below:

SAMPLE RUN

WEINSCHEL ENGINEERING
SYSTEM II
CAL OF 1110 THERMISTOR MT, 201
USING SN108
Date: 11/06/85

FREQ(MHz)	CAL FACTOR
10	.9495
50	.9872
100	.9855
500	.9826
1000	.9700

2.4.7 Outputting Run Data

When a **COMPLete**, **BANDS** or **CONSECutive** run has been performed, the controller displays the OUTPUT MENU:

OUTPUT MENU

The following output options are available:

A. **PLOT**: Plots a graph of the calibration factors on the controller screen.

B. **COPY**: Sends the plotted graph to the preselected printer.

C. **DISPlay**: Displays a table of the calibration factors.

D. **PRINT**: Sends the table of calibration factors to the preselected printer.

E. **PRINT ALL**: Plots and outputs both the graph and table to the preselected printer.

F. **STORE**: Stores the calibration data on the disc/tape. When selected, the program will ask the user for a name under which to store the data.

G. **EXIT**: Ends this menu and advances the display to the THERMISTOR MOUNT NEWRUN MENU (See Paragraph 2.4.8 below).

Once all desired output options have been selected and performed, select **EXIT** to proceed to the THERMISTOR MOUNT NEWRUN MENU. See Paragraph 2.4.8.

2.4.8 Terminating, Repeating, or Reinitiating a Run

The THERMISTOR MOUNT NEWRUN MENU shown below enables the user to terminate the session, repeat a run, or initiate a new run. Upon completion of additional runs, the program returns to the OUTPUT MENU shown in Paragraph 2.4.7.

THERMISTOR MOUNT NEWRUN MENU

```
                WEINSCHEL ENGINEERING
                    SYSTEM II
            CAL OF 1110 THERMISTOR MT, 201
                  USING SN108
                  Date: 11/06/85
Select:

-------------------------------------------------------------------------
                                  Δ CAL      | STOP
RE-RUN        NEWRUN              Δ SER#     | OUTPUT
```

Available options are defined as follows:

A. **RE-RUN**: Upon selection of this option, the System II automatically repeats the run that was just performed using the same parameters.

B. **NEWRUN:** This option allows the user to recalibrate the same mount using a different run type (i.e., **COMPLete**, **BANDS**, **FIXED** or **CONSECutive**). Upon selection, the controller displays the RUN MENU shown in Paragraph 2.4.6.

C. **Δ SER #** (Change Serial Number): This option allows the user to calibrate another mount of the same type (i.e., either an 1109 or 1110), changing only the specific serial number of the mount being calibrated. Selection of this routine allows the label of the mount being calibrated to be updated, leaving all other parameters unchanged. In this way the program provides for accurate identification of calibration output data.

D. **ΔCAL** (Change Calibration Type): This option allows the user to perform a run of a different calibration type. The controller displays the main CALIBRATION MENU shown in Paragraph 2.3. For example, if the calibration of a power meter is desired subsequent to the calibration of an 1109 mount, select the **PMETER SENSOR** option and proceed with the program.

E. **OUTPUT**: This option returns the display to the OUTPUT MENU shown in Paragraph 2.4.7.

F. **STOP**: This option terminates the program session. Press **RUN** to restart the program.

2.5 POWER METER SENSOR CALIBRATION

To use the *S2CAL* program to calibrate a power meter sensor automatically, select the **PMETER SENSOR** option from the CALIBRATION MENU shown in Paragraph 2.3.

Follow the procedures outlined in Paragraphs 2.4.2 through 2.4.4 for entering the data file name of the standard, the adapter data file name (if used), and the amount of dc substituted power.

2.5.1 Power Meter Selection

When these procedures are completed, the controller displays the following menu:

BUS CONTROL MENU

```
                WEINSCHEL ENGINEERING
                     SYSTEM II
                CAL OF A POWER SENSOR
                USING 1109 MOUNT, SN108
                     Date: 11/06/85
Choose power meter type:
      with IEEE bus
      w/o  IEEE bus:
            DVM on Vrf output
            DVM on recorder op
-------------------------------------------------------------------
IEEE bus          Vrf              recorder
```

Compatible power meters are listed in Paragraph 1.3. The program can be run with:

- a digital power meter with an IEEE-bus option;
- a digital power meter without an IEEE-bus option; or
- an analog power meter without an IEEE-bus option.

Digital power meters equipped with interface bus capability may be controlled directly by the controller. Analog power meters and digital power meters not equipped with an IEEE-bus option may be made compatible for use with the System II by connecting them to a bus-controlled digital voltmeter.

2.5.1.1 DIRECT BUS CONTROL

To use a digital meter *with* the IEEE-488 bus option, select **IEEE bus**. The following display appears:

POWER METER MENU

```
                WEINSCHEL ENGINEERING
                      SYSTEM II
                CAL OF A POWER SENSOR
                USING 1109 MOUNT, SN108
                     Date: 11/06/85

Choose power meter - on addr 13

-------------------------------------------------------------------------------
                    MC6960
HP436               GM475          PM1045          BO4200
```

Ensure that the power meter's bus address is set to 13. Select the appropriate power meter option. Follow the prompt to enter the serial number of the selected device. Then proceed to Paragraph 2.5.2 to select a sensor.

2.5.1.2 INDIRECT BUS CONTROL

To use a power meter without interface bus capability, connect the bus to a digital voltmeter. System II compatible voltmeters are listed in Paragraph 1.3. Ensure that the voltmeter's bus address is set to 04. Then connect the digital voltmeter to the recorder output of the power meter. Some power meters (for example, the HP 432) have a V_{RF} output which may be used instead of the recorder output. Determine which type of port is to be used; make the appropriate connections. Then select either **V_{RF}** or **recorder** from the BUS CONTROL MENU shown in Paragraph 2.5.1.

When the **recorder** option is selected, the following menu is displayed:

RANGE & VOLTAGE OUTPUT MENU

```
                WEINSCHEL ENGINEERING
                      SYSTEM II
                CAL OF A POWER SENSOR
                USING 1109 MOUNT, SN108
                     Date: 11/06/85

Choose PM range & output voltage

-------------------------------------------------------------------------------
10mW, 1V        1mW, 1V                                   full, 5V
```

ANALOG METERS

When using an analog meter, set the power range dial on the meter to either 1 mW or 10 mW. Then select either **1mW, 1V** or **10mW, 1V**.

USING A DIGITAL METER WITHOUT THE BUS OPTION

When using a digital voltmeter to control a digital power meter without the IEEE-488 bus option an additional procedure may be required. Many of these models are equipped with auto-range features which enable them to change range automatically. Because the voltmeter has no indication of these range changes, in order to obtain valid readings, this feature must be suppressed. "Fix" the range at either 1 mW or 10 mW and select **1mW, 1V** or **10mW, 1V**. For example, to do this for an HP 436 the following steps would need to be performed:

SUPPRESSING AUTO-RANGE FEATURES ON AN HP 436

A. Attach the power sensor to the power meter's 1 mW port.

B. Press **RANGE HOLD**.

C. Select the **1 mW, 1V** option and proceed with the program.

Some meters, for example, the Marconi 6960, may be capable of a full range with an output of 5 V. If this is the case there is no need to "fix" the range. Simply select **full, 5V**. The program must be edited to accommodate additional range and voltage options if these are required.

Whenever the power meter is being monitored via the recorder output it is essential to ensure that all front panel controls are set correctly as these still affect the reading. If, for example, the power meter has a CAL FACTOR dial, it must be set to 100% to ensure an accurate reading.

Once power meter range and output voltage have been selected, follow the prompts to enter the model and serial number of the power meter. The VOLTMETER MENU is then displayed:

VOLTMETER MENU

```
                WEINSCHEL ENGINEERING
                      SYSTEM II
                CAL OF A POWER SENSOR
                USING 1109 MOUNT, SN108

        PMeter   :  HP431, 2176 on rec
        Sensor   :  ,
        Date     :  11/06/85

Choose voltmeter - on addr 04

-------------------------------------------------------------------------------
                                                                    HP3455
KEITH          FL8500s          DATRON                          HP3478
```

Select one of the available options. These are also listed in Paragraph 1.3.

2.5.2 Power Sensor Selection

Follow the prompts to enter the model number and serial number of the sensor being used.

2.5.2.1 PROVIDING 30-dB ATTENUATOR DATA WHEN USING AN HP 8484

The HP 8484 low-power sensor must be used in conjunction with a 30-dB attenuator. It is necessary, therefore to provide calibration data for the 30-dB attenuator. This information is stored on a data file. When the user indicates he is using an HP 8484, the program automatically requests the data file name of the 30-dB attenuator. Refer to Appendix A for instructions on making, storing and copying data files for this purpose.

2.5.3 Zeroing the Power Meter

The controller displays the following prompt:

Do you want to zero the power meter?

Use the special function keys to indicate yes or no. If **YES** is selected and the power meter is on the bus, the controller automatically performs the function.

If **YES** is selected while using an analog or digital power meter controlled via a digital voltmeter, the program requests the user to manually zero the power meter. Press **CONT** to continue.

2.5.4 Referencing the Sensor

The program then displays the following prompt:

Do you want to reference the sensor against 50 MHz, 1 mW?

Referencing is more often necessary for digital power meters like the HP 436. Analog meters generally do not require it. If **NO** is selected, proceed to Paragraph 2.5.5. If **YES** is selected, the following display appears:

```
EITHER:
        Attach the sensor to the
        System II port
OR:
        Attach the sensor to the
        port on the power meter

Adjust 'cal adjust' until
display on power meter shows:

1.001 or 1.000 respectively

Press 'CONT' to continue
```

Referencing the sensor matches the sensor and power meter together. This is particularly important to do whenever a new sensor has been attached. Follow the prompt, attaching the sensor to either the port on the System II or the power meter. It is preferable to attach it to the System II. If the sensor is attached to the System II, turn the **CAL ADJUST** screw, using a small screwdriver, until the meter reads the first value displayed (1.001 in the example shown above). Turn it until the meter reads 1.000 if the sensor is attached to the power meter itself. The System II value may not be exactly 1 mW because of losses in the 1109 mount; therefore, the amount of power being output by the System II is precisely calculated and displayed.

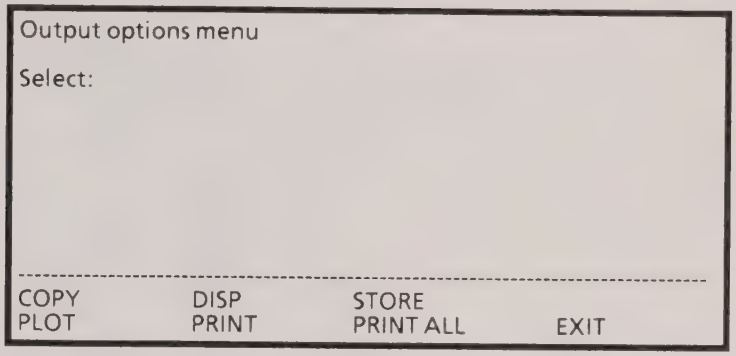
2.5.5 Performing a Calibration Run

Once all operating parameters have been selected and the sensor has been referenced (if desired), the controller then displays a RUN MENU similar to that shown in Paragraph 2.4.6. The power meter RUN MENU differs only in the heading. (The heading should say "CAL OF A POWER SENSOR" and should list the type and data file name of the standard, as well as the model and serial numbers of the meter and sensor.) Refer to Paragraph 2.4.6 for instructions on performing a run.

2.5.6 Outputting Data

When a **COMPLete**, **BANDS**, or **CONSECutive** run has been performed the controller displays the OUTPUT MENU shown below:

OUTPUT MENU

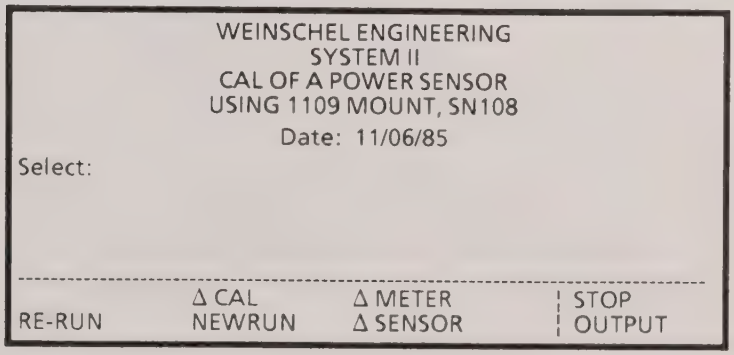


Refer to Paragraph 2.4.7 for a definition of output options.

2.5.7 Terminating, Repeating or Reinitiating a Run

Upon completion and output of a run, the program displays the POWER METER NEWRUN MENU shown below:

POWER METER NEWRUN MENU



Available options are defined as follows:

A. **RE-RUN**: Upon selection of this option, the System II automatically repeats the run that was just performed using the same parameters.

B. **NEWRUN:** This option allows the user to recalibrate the same mount using a different run type (i.e. **COMPLete**, **BANDS**, **FIXED** or

CONSECutive). Upon selection, the controller displays the RUN MENU shown in Paragraph 2.4.6.

C. **Δ SENSOR** (Change Power Sensor): This option allows the calibration of a power meter to be repeated, changing the type and serial number of the sensor only. Refer to Paragraph 2.5.2 and proceed with the run.

D. **Δ METER** (Change Power Meter): This option allows the calibration of a power meter sensor to be repeated, changing the type and serial number of the meter being used. When this option is selected, the program returns to the menu shown in Paragraph 2.5.1.

E. **Δ CAL** (Change Calibration Type): This option allows performance of another run of a different calibration type. The controller displays the main CALIBRATION MENU shown in Paragraph 2.3. For example, if calibration of an 1109 is desired subsequent to calibration of a power meter sensor, select the **1109** option and proceed with the program.

F. **OUTPUT**: This option returns the display to the OUTPUT MENU shown in Paragraph 2.5.6.

G. **STOP**: This option terminates the program session. Press **RUN** to restart the program.

SECTION 3
PRINCIPLES OF OPERATION

3.1 THERMISTOR MOUNT CALIBRATION EQUATIONS

Figure 3-1 illustrates the variables taken into account in thermistor mount calibration.

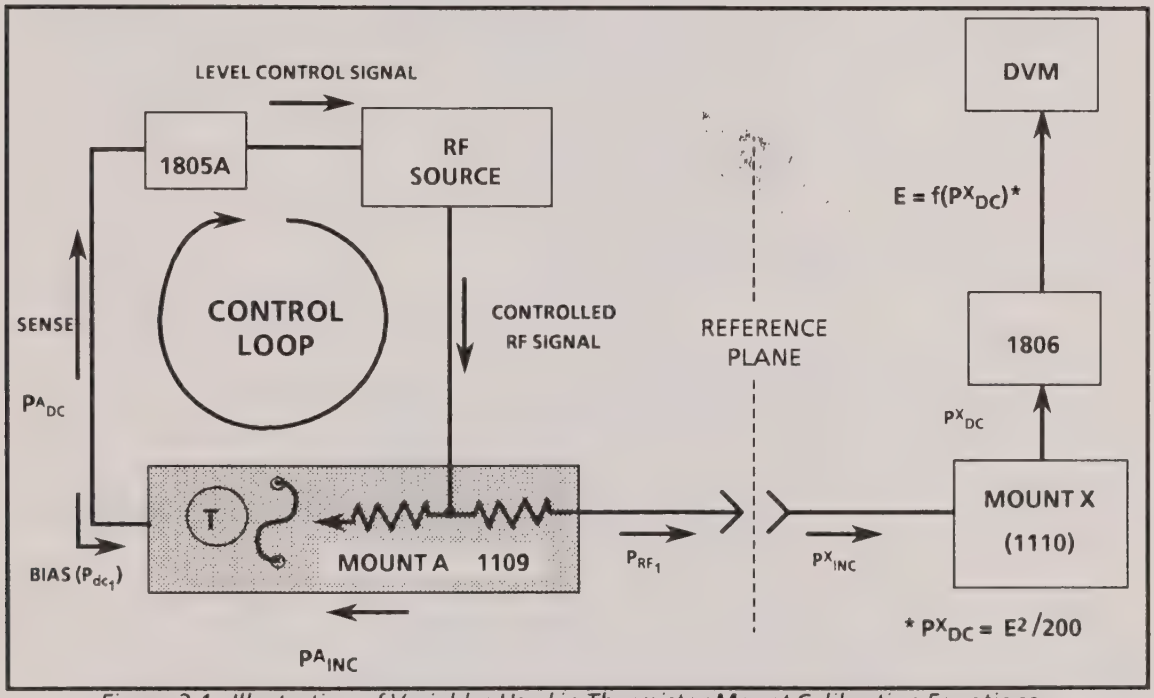


Figure 3-1. Illustration of Variables Used in Thermistor Mount Calibration Equations

The following equations are used in thermistor mount calibration:

$$P^A_{DC} = K_A P^A_{INC}$$

$$and\ P^X_{DC} = K_X P^X_{INC}$$

where:

K_A and K_X are calibration factors of mounts A and X,

P^A_{DC} = dc substituted power provided by the 1805A,

and

P^X_{DC} = dc substituted power provided by the 1806 Bridge and read by the digital voltmeter.

In other words,

dc substituted power = (incident power)(loss through mount)*

If the incident power is known (from the 1805A) and the substituted power is measured, then the calibration factor can be calculated.

3.2 POWER METER CALIBRATION EQUATIONS

The following equations are used in the calibration of a power meter. When mount X is unknown, the power meter case is identical to thermistor mount calibration.

$$K_X = \frac{P^X_{DC} \cdot K_A}{P^A_{DC}}$$

Where P^X_{DC} = *reading from the power meter (mW),*

P^A_{DC} = *DC substituted power, and*

K_A = 1109 *calibration factor.*

In one case, the power meter measures in dB, but displays the result as a calibration factor

$$\textit{calibration factor} = 10^{-\left(\frac{dB}{10}\right)}.$$

APPENDIX A
CREATING SYSTEM II COMPATIBLE DATA FILES

A.1 CREATING SYSTEM II COMPATIBLE DATA FILES USING THE "MANIDF" PROGRAM

Data files are required by the main System II program in three routines:

- providing the data for the known thermistor mount;
- providing the data for an adapter if one is being used;
- providing data for a 30-dB attenuator which is used in conjunction with the HP 8484 low-power sensor.

In order for a data file to be read by the system, it must be in the System II format. This format lists 109 frequencies (MHz) and their corresponding calibration factors. The System II software package includes a program, *MANIDF*, which allows the user to make, print, and copy data files for a thermistor mount, an adapter, or a 30-dB attenuator.

The *MANIDF* program provides the only means of copying data files when an HP 85 is being used to control the system; it is therefore essential for use with that controller. In addition, it is also useful whenever existing datafiles must be examined, or when new data files are to be created from hard copy data.

While the program is mostly menu-driven, in some cases, it may be necessary to edit the program. To edit the program press **LIST** (on the HP 85 and 86) or type "Edit" (on the HP 200 Series). These actions result in a listing of the program on the screen.

A.2 LOADING AND RUNNING THE "MANIDF" PROGRAM

To run the *MANIDF* program:

A. Power up the controller.

B. Insert the software tape/disc.

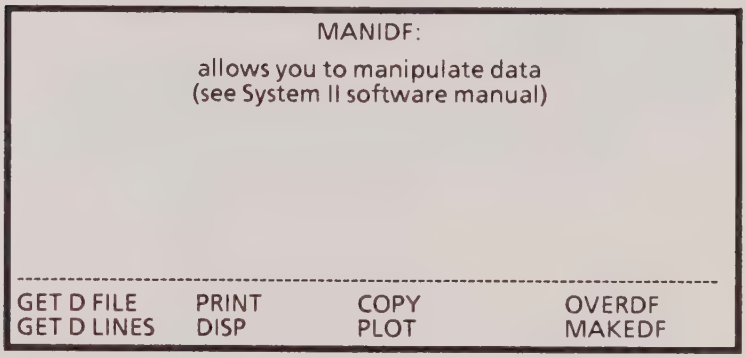
C. Enter *Load "MANIDF"*.

D. Allow a short time for the program to be accessed.

E. Press the **RUN** key.

The following menu is displayed:

"MANIDF" MENU



Available options are defined as follows:

A. **GET Data FILE**: retrieves data stored in a data file on the tape/disc and holds it in memory.

B. **GET Data LINES**: retrieves data listed in the data lines of the program itself and holds it in memory.

C. **PRINT**: outputs the held data to the printer.

D. **DISPlay**: displays the held data on the screen only.

E. **PLOT**: plots the held data on a graph on the screen.

F. **COPY**: outputs a plotted graph to the printer.

G. **MAKE Data File**: is used to create a new data file on the tape/disc from held data.

H. **OVERwrite Data File**: allows the user to overwrite an old data file with new data. This is used, for example, to correct a data file.

A.3 REVIEWING EXISTING DATA FILES

To review a data file already on the system:

A. Select **GETDF**. Follow the prompt to enter the name of the desired data file.

B. Select either **DISPlay** or **PRINT** (for a hard copy).

C. If a graph is desired, once the data has been retrieved, select **PLOT** to show a graph on the display and **COPY** to send the graph to the printer.

A.4 COPYING AN EXISTING DATA FILE ONTO ANOTHER TAPE/DISC

To copy an existing data file onto another tape/disc perform the following steps:

A. Select **GETDF**.

B. Enter the file name of the data file to be copied.

C. Remove the old tape/disc and insert the new one.

D. Select **MAKEDF**.

E. Enter the name under which the copied data file is to be stored on the new tape/disc.

A.5 MAKING NEW DATA FILES FROM WEINSCHEL HARD COPY DATA

In some cases it may be necessary to create a data file from hard-copy calibration data provided by Weinschel Engineering. Enter this data directly into the data lines of the program by performing the steps below:

A. Display the program listing on the screen. Scroll to the program's data lines. The location of these data lines may be determined by listing Line 100 of the program.

B. Enter the Weinschel data as F, K where F = frequency (MHz) and K = calibration factor. For example:

```
DATA 10, .9937
DATA 50, .9897
DATA100, .9917
:
etc.
```

C. It is recommended that you make a backup copy of the program (under another name) at this point to ensure against loss of data due to power failure, etc.

D. **RUN** the program.

E. Select **GETDL** and **PRINT** (or **DISPlay**).

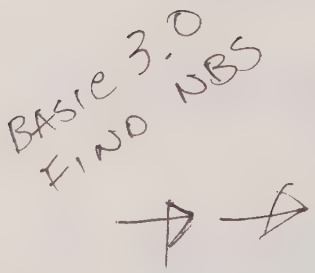
F. Review the data to ensure that it was entered correctly. If corrections are necessary, repeat Steps A thru E above, altering the incorrect data lines.

G. When the data has been verified as correct, press **MAKEDF**.

H. Enter the name of the new data file.

A.6 MAKING NEW DATA FILES FROM NBS HARD COPY DATA

In some cases it may be necessary to create a data file from hard-copy calibration data provided by the National Bureau of Standards. The NBS supplies calibration factors for the first five data points. It supplies calibration data for the remaining points in terms of frequency, efficiency and reflection coefficient, from which the calibration factor, K, must be calculated. The NBS data must be entered in the data lines, and the NBS subroutine must be enabled. This subroutine converts NBS data to System II format by calculating the calibration factor. Proceed as follows:



A. Display the program on the screen.

B. Scroll through the program to get to the lines labelled "NBS".

C. Suppress the line which reads:

```
READ F(I), K(3,I)
```

by inserting an exclamation point (!) at the beginning of the line.

D. Enable the NBS subroutine by removing the exclamation points (!) which begin the lines which read:

```
! IF I< = 5 THEN READ F(I), K
! IF I>5 THEN READ F(I), E, R @ K = E*(1-R*R)
! K(3,I) = K
```

E. Scroll through the program to get to the data lines. Since NBS provides calibration factors for the first five data points, enter these calibration factors directly in the data lines as F, K. Enter the NBS data for the remaining points as F (frequency), E (efficiency), and R (reflection coefficient). For example:

```
DATA  10, .9323
DATA  50, .9894
DATA 100, .9891
DATA 500, .9842
DATA1000, .9749
DATA1050, .9797, .018
DATA1100, .9790, .018
DATA1150, .9778, .017
   ⋮
  etc.
```

F, K

F, E, R

F. **RUN** the program.

G. Select **GETDL** and **PRINT** (or **DISPlay**).

H. Review the data to ensure that it was entered correctly. If corrections are necessary, repeat Steps E thru G above, altering the incorrect data lines.

I. When the data has been verified as correct, select **MAKEDF**.

J. Enter the name of the new data file.

A.7 MAKING ADAPTER DATA FILES

If an adapter is to be used between mounts in the System II it is desirable to create a data file for the adapter. If calibration factors are already known for the adapter, follow the procedure outlined in Paragraph A.5, entering the data directly into the program's data lines.

If the data is not known, the System II can be used to measure the adapter. Set the System II up as shown in Figure A-1, inserting *two* well-matched adapters between the 1109 and the 1110. It is necessary to use two adapters to offset the fact that all System II components have compatible connectors. It must be assumed that the two adapters are well-matched so that we can attribute identical calibration factors to each.

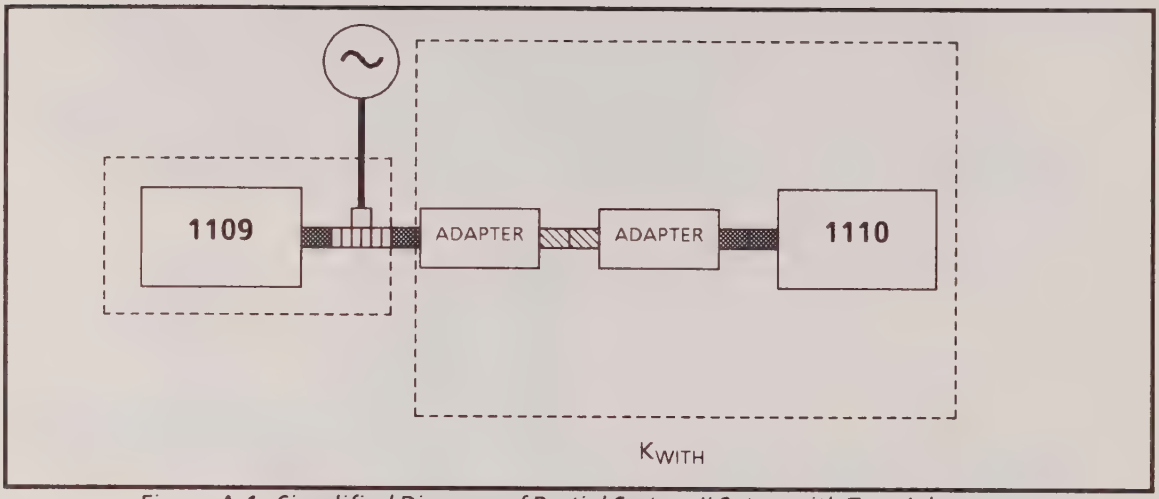


Figure A-1. Simplified Diagram of Partial System II Setup with Two Adapters

A. Using an 1109 mount and an 1110 mount, both with known calibration factors, load and run the *S2CAL* program. In selecting the appropriate program parameters, proceed as if calibrating an 1110 with *no* adapters.

B. **STORE** the data under the file name "WITH". The file "WITH" now contains calibration data such that:

$$K_{WITH} = K_{1110} \times K_A \times K_A$$

$$where\ K_{1110} = calibration\ factor\ of\ the\ 1110$$

$$and\ K_A = calibration\ factor\ of\ each\ adapter$$

C. Load the *MANIDF* program.

D. Display the program listing on the screen. Scroll through the program to get to the lines labelled "adapter".

E. Enable the adapter subroutine by removing the exclamation points (!) which begin the "adapter" lines. These are:

```
! DISP "Enter Q, array position" @INPUT Q
```

and

```
! IF Q = 2 THEN K(3, I) = SQR(K(1,I)/K(2,I))
```

F. **RUN** the program.

G. Load datafile "WITH" into array 1 (i.e., Q = 1).

H. Load datafile "1110" (i.e., the file name of the 1110) into array 2 (Q = 2).

I. The program calculates K_A such that

$$K_A = \sqrt{\frac{K_{WITH}}{K_{1110}}}$$

and lists F, K_A.

J. Select **MAKEDF.**

K. Enter the name of the new data file.

A.8 MAKING A DATA FILE FOR A 30-dB ATTENUATOR

When calibrating an HP 8484 low-power sensor, the *S2CAL* program automatically requests calibration data for the 30-dB attenuator used in conjunction with the HP 8484. This information must be pre-stored in a data file. Obtain attenuation data for all 109 frequency points. Then:

A. Display the program listing on the screen. Scroll through the program to get to the data lines. Enter the attenuator data in the data lines as F, K. For example:

```
DATA   10, 29.8
DATA   50, 29.8
DATA  100, 29.9
DATA  500, 29.9
DATA 1000, 30.0
  ⋮
 etc.
```

B. **RUN** the program.

C. Select **GETDL.**

D. **PRINT** or **DISPlay** the data file. The controller will list F, K.

E. Review the data to ensure that it was entered correctly. If corrections are necessary, repeat Steps A thru D above, altering the incorrect data lines.

F. When the data has been verified as correct, select **MAKEDF.**

G. Enter the name of the new data file, e.g. "30dB". This file contains the original attenuation data, not yet converted to calibration factors.

H. Display the program listing on the screen. Scroll through the program to get to the line labelled "30dB pad".

I. Enable the 30-dB pad subroutine by removing the exclamation mark (!) which begins the line which reads:

```
! K(3,I) = 10^(-K(3,I)/10))
```

J. **RUN** the program.

K. Select **GETDF** using the file name selected above for the file with the original attenuation data (e.g. "30dB"). The program calculates the calibration factors (K) as it reads the data such that

$$calibration\ factor = 10^{\left(-\frac{Att}{10}\right)}$$

L. Select **MAKEDF**.

M. Enter the name of the new data file, e.g. "30CF". The data file is now ready to be used in the System II program.

SYSTEM II SOFTWARE OPERATIONS MANUAL(IM-181)

REVISION RECORD

REVISION	DATE	DESCRIPTION	APPLICABLE SERIAL NUMBERS
A	March 1986	Initial issue.	All units.

www.manualsplus.com
1027028

SE Laboratorios
LOC. U4
MAN - 03511